Progress Report 60-6586 61

Period of 9-15-61 to 10-15-61

Contract No. AF33(600)40280

General

Major activities for the monthly reporting period:

1. Reviewing antenna mounting problem.
2. Investigating doppler tracking of return.
3. Fabrication and testing of radar units.
4. Organizing and starting the flight test program.

The chart, Figure 1 shows in graphical form the status of the first radar system.

A schedule has been prepared covering all effort on the AN/APQ-93 radar system under contract and negotiation. See Figure 2.

PROJECT STATUS

% COMPLETION OF 1ST RADAR FOR PERIOD ENDING 15 OCT. 1961

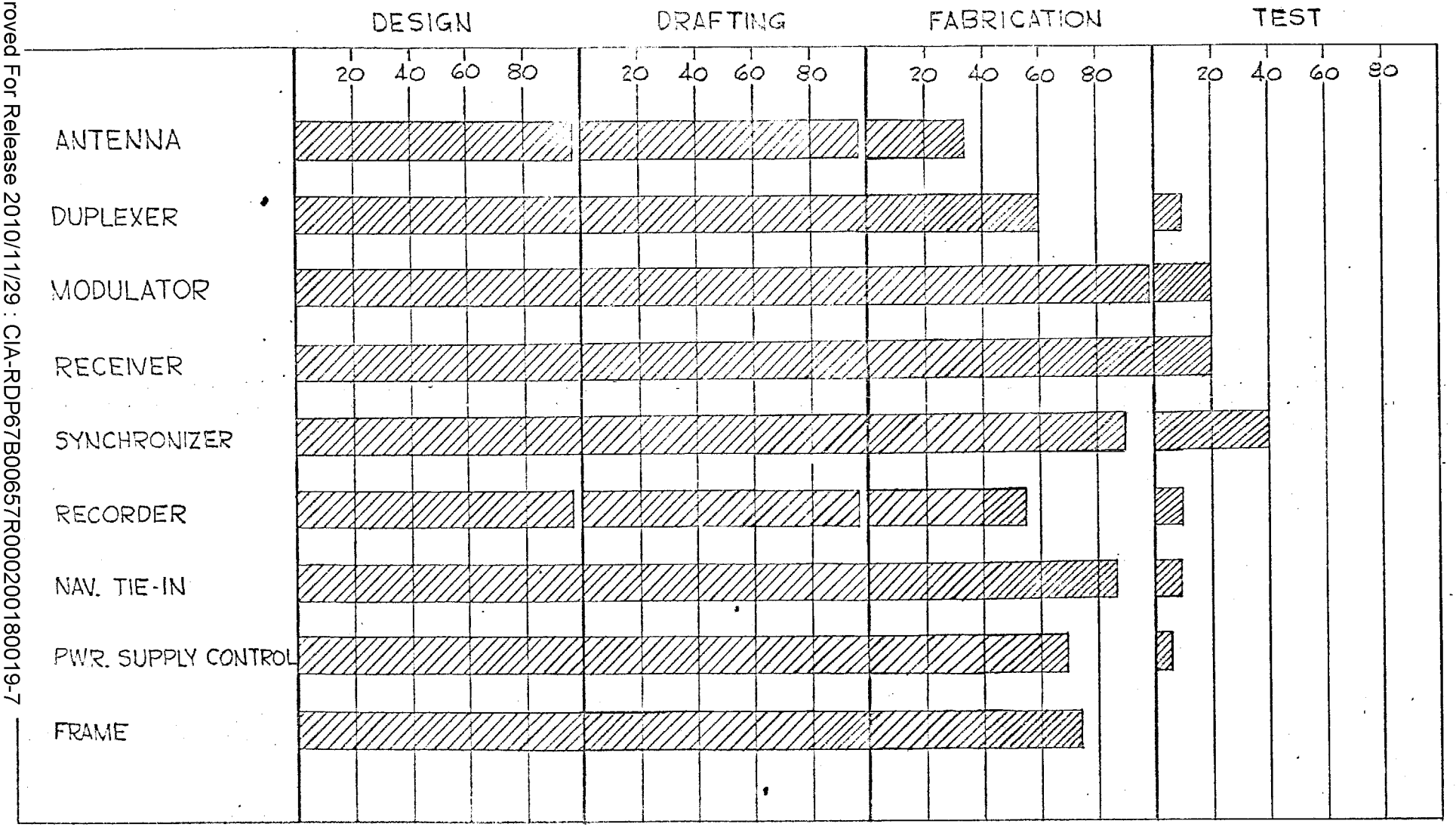


Figure 1

Approved For Release 2010/11/29 : CIA-RDP67B00657R000200180019-7

SCHEDULE FOR AN/APQ-93 RADAR

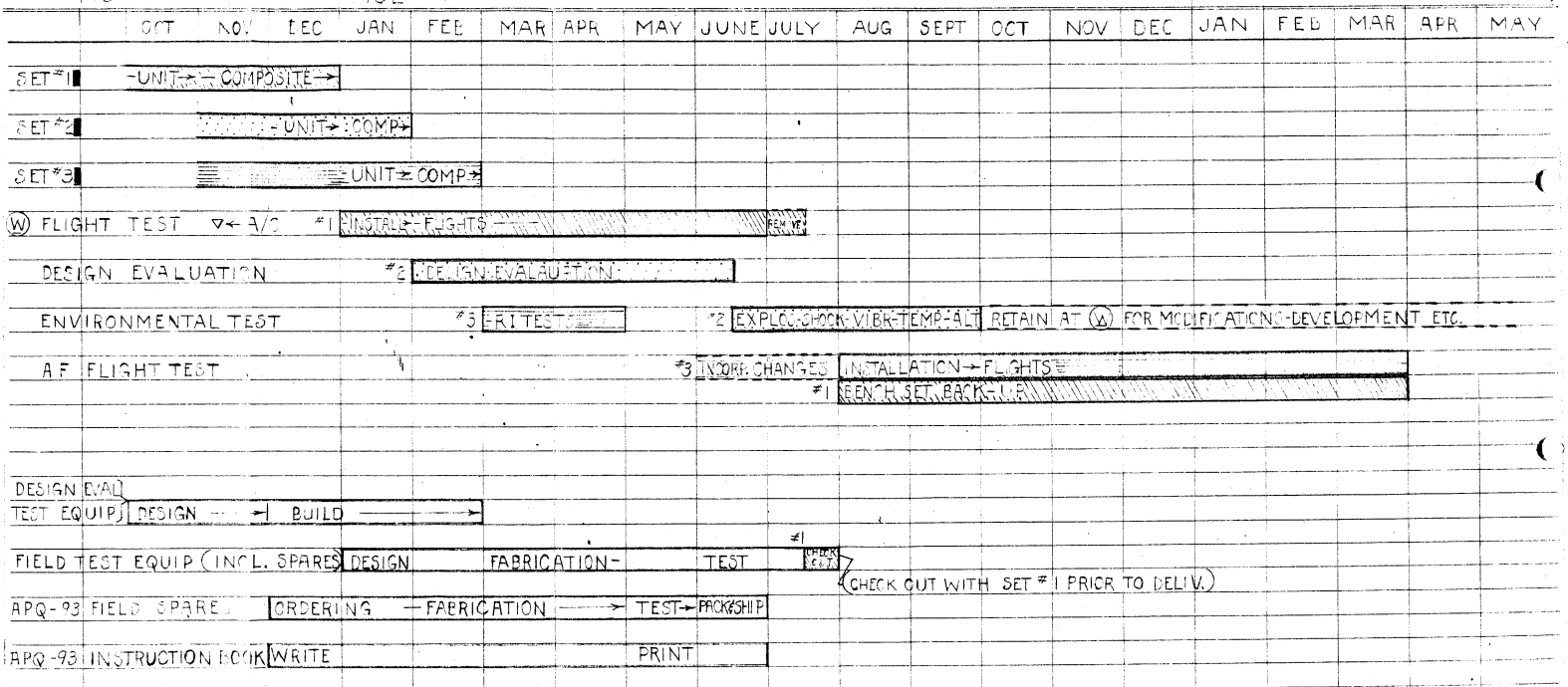


Figure 2

Test Programs

A proposal was submitted (45196-5) covering the following:

1. Design Evaluation Tests.
2. Environmental Tests.
3. Special Field Test Equipment.
4. Informal Instruction Books.

Also submitted were budget estimates for the following:

1. AF Flight Test Support.
2. Spares for Special Field Test Equipment.

Flight Test

It has been established that the flight conditions for the APQ-93/F-101B test program will be:

1. Altitude 40,000 feet
   Ground speed - 530 knots
2. Altitude 40,000 feet
   Ground speed - 830 knots

All flights will be made on autopilot for optimum stability, heading, and altitude control.

The aircraft assigned to this program is currently located at Wright-Patterson Air Force Base and is scheduled for delivery around November 1, 1961.

Auxiliary instrumentation design has begun. This instrumentation will provide an aircraft motion history and APQ-93 circuit performance data which will be time correlated with the APQ-93 system data. An interim instrumentation system is in fabrication and is about fifty percent complete.

This interim system (vertical gyro, normal and lateral accelerometers) will be installed in the aircraft shortly after it is received to obtain preliminary information on aircraft stability at the proposed operating conditions.

A layout drawing of equipment on the primary rotary armament door has been completed. Detail installation drafting of the APN-102 and APQ-93 antenna pod design have begun.

Liaison has been established with McDonnell Aircraft Corporation, and a meeting has been arranged to discuss the antenna pod installation with structural and aerodynamic engineers at McDonnell.

Training of the aircraft maintenance crews began on October 9 and will continue through October 27.

Pilot ground schooling also began on October 9 and was completed two weeks later.

System

During the past month system investigation has continued on the spatial bandwidth problem. In particular, the following investigations have been undertaken.

The impossibility of compensating for antenna pitch angle has been verified. The basic cause of this is that the resulting intercept of the beam on the ground is not a member of the family of constant doppler lines. This can be corrected in three ways. First, the antenna can be so located that it lies parallel to the flight path. This is possible if the antenna is cut to 10 feet. Second, by a combination of about 8° sideward

cant and 4° pitch a location can be found where the antenna lies on the specified aerodynamic surface and the beam intercept approximates a constant doppler line. This however, requires changes in the correlator to handle the incremental range change while the target is in the beam. Thirdly, the antenna position can be changed as above, and the beam squinted aft so that the intercept approximates the zero doppler line. This trades the correlator modification for an extensive antenna modification.

Investigation of the relative difficulties of these approaches is continuing.

Investigation of an automatic doppler tracking technique was undertaken. This technique, if successful, would eliminate the need for navigation system information.

Antenna

Radome Laminate Design

Methods of sealing the slotted array sticks which are being investigated are: (1) Dupont ML fabric with DC silicone adhesive (without iron oxide and without carbon black) held in place by a special clamp and (2) a sandwich of ML fabric between two sheets of nickel (using silicone adhesive only as a sealant) joined to the sticks by metals joining techniques. The first of these methods appears to be most promising on the basis of pressure and temperature tests currently underway.

Another class of high temperature resins - diphenyl oxides - have been investigated for the purpose of sealing the slotted array sticks. This investigation has been terminated, however, because of unsatisfactory electrical test results.

Outside Radome

Electrical test results of the "B" sandwich panel were unsatisfactory; however, since the "A" sandwich construction was previously found to be satisfactory, the test of the "B" sandwich was mainly of academic interest only.

Fabrication

The supplier of electroformed manifolds and slotted array sticks has performed necessary tooling rework and is presently electroforming array sticks and manifolds. Delivery of manifolds is promised to start 10-18-61, and delivery of array sticks is promised to start on 10-20-61.

Three stainless steel honeycomb beams were received and inspected. X-rays revealed a 90% void in the vicinity of one support for beam number 1. Beams number 2 and 3 were found to exceed the specified flatness tolerance. The measured dimensional deviations of beams 2 and 3 were fed into a digital computer program to determine their effect on the horizontal plane pattern of the array. Results of the computer program indicate that beam number 3 can be used. Beams number 1 and 2 are being returned to the supplier for rework or replacement.

The solid magnesium beam for the flight test program was received on 10-12-61.

Duplexer

Airtron now expects to ship the first of three production resonant rings (all three are being fabricated simultaneously) during the week of October 23. Invar hobbing difficulties for sidewall, topwall coupler section, as well as electrical tests on the new S.E.I. section, have caused this delay.

Fabrication of the duplexer frame and associated waveguide is proceeding satisfactorily.

Duplexer Driver

Fabrication is proceeding satisfactorily.

Power Monitor

Parts delivery still prevents delivery.

Switch Tubes

A WEh55A design was tested which had good low level characteristics but only fair high level properties. A VSWR of 1.02 was obtained at the frequencies of interest. However, the triggering of this tube was not particularly good. A new approach to triggering is now being investigated which will put the triggering discharge in the same plane as the RF electric field. The new design for the triggering electrode has the advantage of obtaining a low VSWR (about 1.02) while enabling a DC discharge to be made parallel to the RF field.

Unfortunately, the new design has not been tried under high power conditions because of test modulator troubles. The modulator ring combination has not been developing the power that is needed and a new modulator capable of giving rated 250 KW has recently lost its power transformer. Future work will consequently be done at power levels of 60-100 KW.

A dual tube was constructed for delivery on the October 1 date. However, this tube had a damaged window after testing and showed poor triggering. Consequently, the tube is being held for further modifications.

Modulator

The pulse transformer which was reported last month as having operated successfully has since failed. Inspection revealed signs of

overheating and arcing through the insulation. Further redesign to eliminate those troubles resulted in a transformer which operated for several days with no signs of overheating when opened up for inspection. In addition to this improvement, the new design permits fitting the transformer in the original case. Delivery of the first unit is expected on or about 1 November 1961.

The modulator was returned to the Model Shop for installation in the casting and mounting of the klystron. Temporarily, a pulse transformer which will operate at reduced voltage has been installed to permit checking out the modulator pending receipt of the new transformer.

Receiver

TWT

The first TWT assembly is complete with the exception of one high voltage connector which has not yet been received.

IF Amplifier

The first amplifier will be received from the shop this week and placed in unit test. The other two units are now in wiring and need only the installation of the transformers to be complete.

Video Amplifier

The first video amplifier is in unit test. The other two are in the shop (one in inspection and one in wiring). Work is being done with breadboard units to speed up AGC response.

Synchronizer

Frequency Generator

Units for the first system have been reworked and checked out as individual units. The frequency generator has not, however, been checked out as a complete unit and so far, it has not locked-up properly under closed-loop operation.

Synchronizer Generator

All unit testing has been completed.

Synchronizer Chassis

The first chassis is now being unit tested.

Oscillator-Discriminator

This unit has, in effect, never been received from Sulova since both units received from this supplier have been defective. A third unit scheduled for delivery on 10-11-61 has been re-scheduled for 10-16-61. Sections of the other two units have been used during the present testing program.

STALO

The first receiver unit containing the microwave oscillator and associated waveguide has been received from the Model Shop. (IF amplifier not included). Some component changes affecting loop corner frequencies have been made to reduce klystron repeller voltage disturbances in closed loop operation.

Testing of this unit is estimated to be 50% complete.

Recorder

General

Testing of various components of the recorder was continued. Modification to the design was made to incorporate flight test requirements.

Mechanical

The recorder was partially disassembled and necessary machining was done to accept precision pulley assemblies that are being manufactured by Barden Bearing Corporation. These assemblies which will not have more than 40 micro inch eccentricity are expected during the first week in October.

The auxiliary data projector assembly has been modified to include cue lights for vehicle speed indication.

Loop sensor switches were selected and installed in the recorder.

Drawings are being brought up to date and released for manufacture of units no. 2 and 3.

Photographic

Photographic tests of the resolution of the [illegible]4745 cathode ray tube with fiber optic insert and S02L3 film in combination were initiated during the month. The pattern resulting from square wave modulation of the CRT grid through a range of frequencies was exposed onto the S02L3 film held in contact with the fiber optic face plate. The resulting exposures after development are being read with a micro-densitometer to obtain the modulation amplitudes as a function of frequency. At the moment, results indicate lower resolution than was expected from results of our initial study. Attempts are being made to determine the causes of resolution loss.

A sample fiber optics array has been received. This sample is now being potted.

Magnetic Field Interference Tests

A large magnet used on a klystron was placed near the shielded CRT and found not to disturb the trace significantly. Most severe trace movement occurred when the magnet was moved about 18 inches from the face plate of the tube. This was the most severe test for our CRT since the face plate will not be pointed directly at the strong magnetic field. Also the magnet will be more than 18 inches away from the CRT.

Modification For 8 KC Sweep and 4 KC Blanking

Minor changes in component values and the use of a 0.75 mh yoke have shown the 8 KC triangular sweep to be possible. The yoke used in the experimental set-up was the same as used for the 4 KC sweep except the series windings were paralleled to present about 0.75 mh (DC resistance under 1.0 ohm) to the switching transistors. These switching transistors dissipate appreciably more heat but are still within safe limits since they are 90 watt devices.

Two resistors have been added to the focus mod. circuit to enhance the half sine waveform and lessen distortion. The .05 uf capacitor in the tuned shaping circuit was lowered to .022 uf to produce the proper 8 KC waveshape and silicon IN458 diodes replace the germanium GTP462 to improve reliability. The high voltage driver was disconnected from the 8 KC flip-flop and will be driven by the 4 KC blanking flip-flop.

It has been determined that an input pulse train of 40 nanoseconds, 10V, 50 ohm pulses are now needed at 16 KC in addition to the 8 and 4 KC already being provided.

Difficulty in triggering the medium speed 2N404 transistors used in the input sync flip-flop has been overcome by using high speed mesa epitaxial germanium 2N781 transistors. These Sylvania 2N781 units in the miniature TO-18 package are also used in the blanking flip-flop for the modification.

Figure 3 shows the complete 4 KC blanking circuit. The flip-flop output is AC coupled to the 2N690 which is a silicon high frequency high voltage unit. The collector output voltage switches the cathode alternately to zero and +60 volts. The CRT is effectively blanked or cut off when the cathode is switched to +60 volts.

A progress photograph of the recorder partialled assembled is also included. (Figure 4).

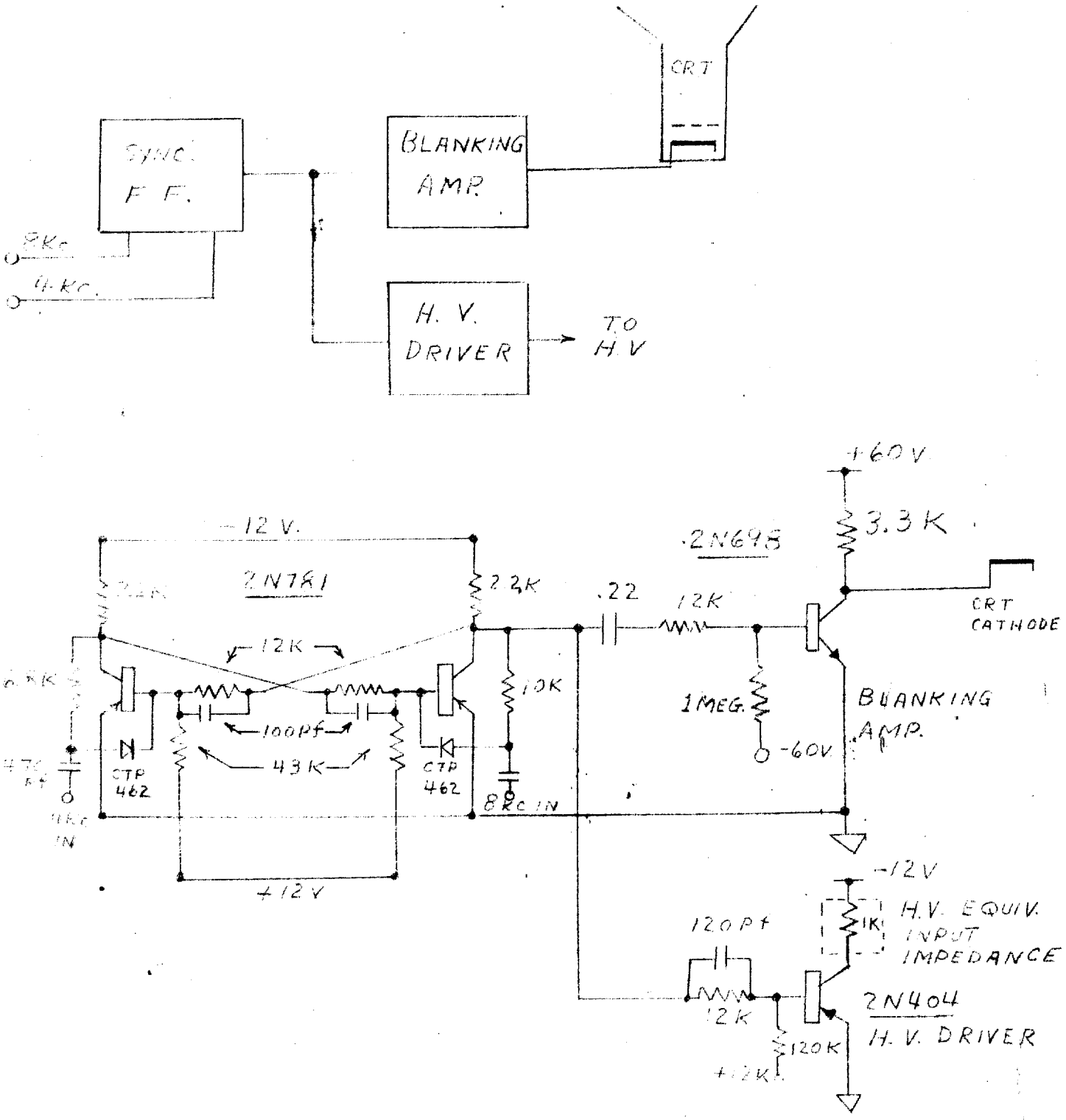
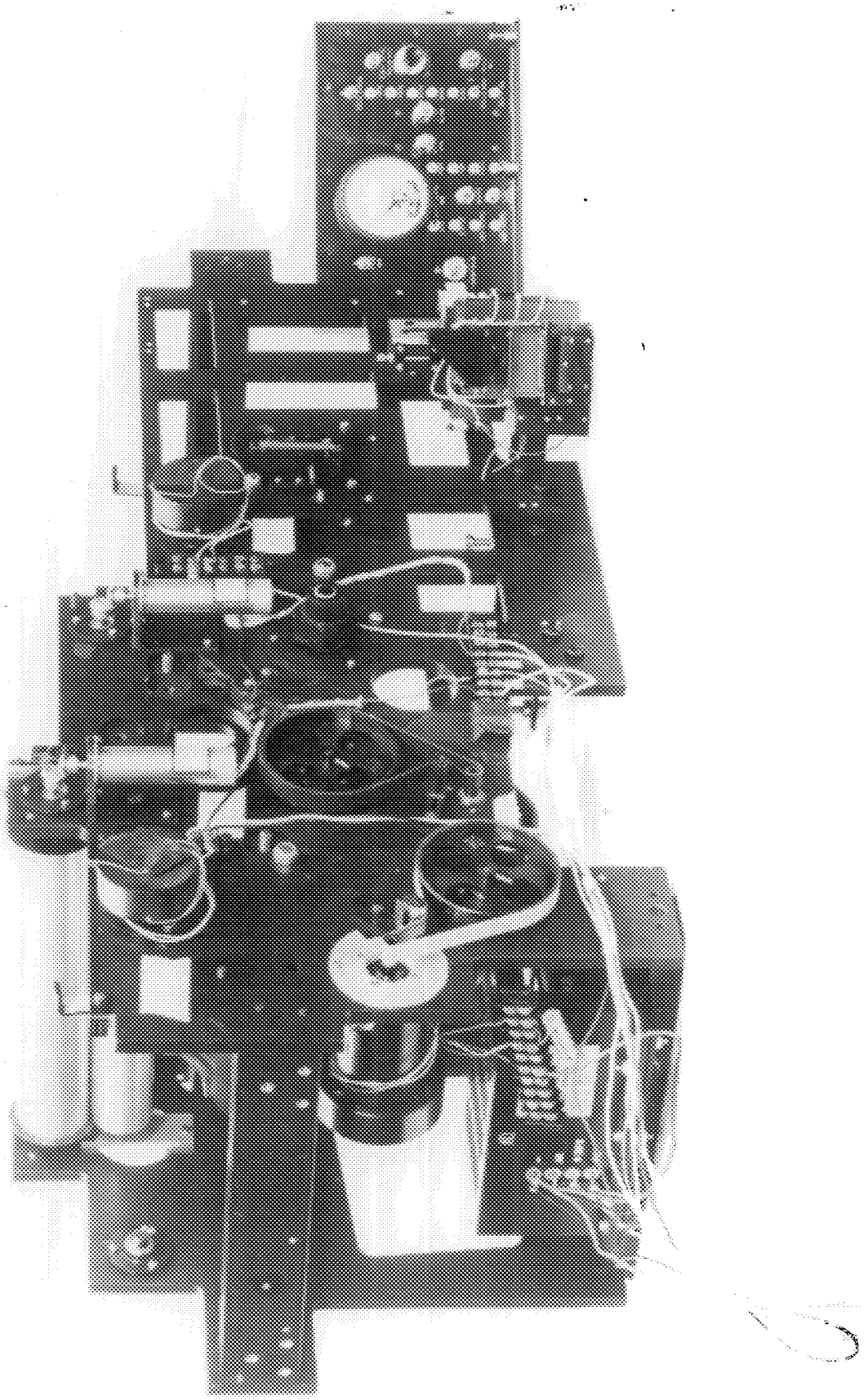


FIGURE 3



Navigation Tie-In

The first unit has just been received from the shop minus the pitch motor assembly, gain-adjust assembly and accelerometer amplifier.

Tests on the servo amplifier are now being conducted and one unit has been returned to the shop for improved mechanical design against vibrations.

The promised shipping date of the pitch motor assemblies is now 10-20-61. These units were delayed several weeks due to the slow delivery of the synchros.

Power Supply and Control

One power supply was released by the model shop for unit test on 10-16-61.

The control panel switch was returned from Oak Switch Co. on 10-12-61.

All control panels have been assembled and are now being wired. It is estimated that the first one of these will be released by the Model Shop on 10-23-61.

Frame (Electrical)

The Model Shop is now wiring the frame to the final version of the wiring tabulation and release of the tabulation will be made upon completion of the first frame wiring which is now 70% complete.

Approximately 98% of all purchase parts for the frame have been received.

All frame junction box drawings have been released.

Frame (Mechanical)

All piece parts and subassemblies have been completed. Assembly of the frame for system #1 is approximately 50% complete.

The first system interconnecting cable is being developed on the mock-up and is approximately 75% complete.

Cable clamp locations and other changes required to install the cable are now being applied to the #1 frame.

Truss

Drafting of the truss was not started during this reporting period. It was felt that more could be achieved by applying maximum effort to the frame and re-scheduling drafting on the truss until the next reporting period.

Stress Analysis

The status of this item remains as previously reported.

Unit Test Cables

Test cables for the first system are 75% complete.

The cables for systems 2 and 3 are 50% complete and will have connectors added for patch cables.

Approximately 85% of the purchase parts have been received.

Composite Test Equipment

The design and breadboarding of this equipment is approximately 50% complete.

Fast switching diodes have been obtained for the crystal switches and it has been determined through tests that a pair of switches in series will provide isolation in excess of 45 db. This allows a safety margin of over 10 db and the insertion loss is no greater than 2 db.

A 120 MC isolation and driver amplifier, which will be used to drive the mixer in the transponder, has been breadboarded and is now under test in the lab.

The trigger circuitry and pulse generator of the range pattern generator have been tested with the crystal switches of the transponder. (These switches will form the pulse that will simulate the RF return). An RF source of 2-3 milliwatts was used. In order to observe the pulse shape the RF pulse was detected and the envelope was displayed on a scope. The width at the 50% point was 10 M-sec. The rise time was 2.0 M-sec. and the on to off ratio better than 40 db. (Ref. Figure 5).

Final configuration of the firmed up circuitry is progressing satisfactorily and fabrication is approximately 10% complete.

The overall package configuration has been determined and a suitable rack has been ordered. Mechanical design of the remainder of the package is now in process.